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U. S. Department of Agriculture

Office of Experiment Stations.

DRAINAGE INVESTIGATIONS.

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A Report  
upon the  
DISMAL SWAMP  
VIRGINIA AND NORTH CAROLINA

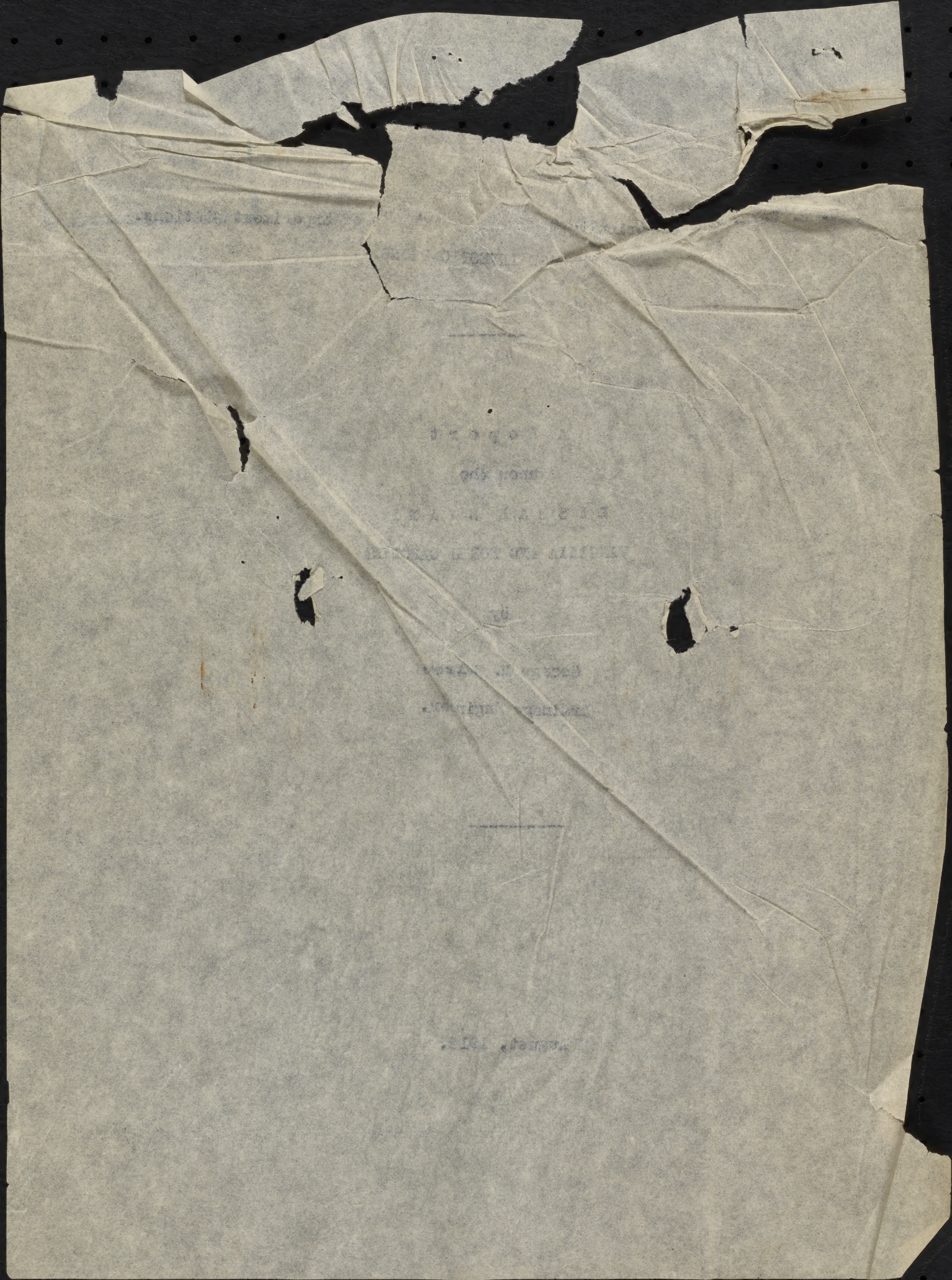
by

George M. Warren  
Drainage Engineer.

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August, 1912.







## THE DISMAL SWAMP.

The Dismal Swamp is the most northerly portion of that characteristic area of palustrine forest occupying a large part of the South Atlantic coastal plain, and next to the Everglades of Florida constitutes the largest single area of morass to be found along the Atlantic seaboard.

Prior to the invasion of the lumberman and the agriculturist, the confines of the Dismal Swamp extended far beyond their present limits, and may have embraced a territory including lesser contiguous swamp areas of 2200 square miles.<sup>1</sup> This great area comprised nearly all the territory lying between the James River, Hampton Roads, and Chesapeake Bay on the north, Albemarle Sound on the south, the Atlantic Ocean on the east, and the Nansemond escarpment on the west, the latter boundary being a fairly well-defined ancient sea beach extending southward from near Suffolk, Virginia, to Albemarle Sound and situated about 40 miles west of the present shore line and apparently formed at a time when the coastal plain was at a much lower elevation than it now occupies.

What are today generally regarded as the confines of the Dismal Swamp comprise an area of about 750 square miles, more than one-third the area of the State of Delaware and nearly two-thirds the area of the State of Rhode Island, although it should be noted that many acres of the higher parts of this territory through partial drainage and conversion to agricultural uses have lost practically all the characteristics of

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<sup>1</sup>Shaler, 10th Annual Rep. U. S. Geol. Survey, p. 318.



THE ATLANTIC SWAMP.

The Atlantic Swamp is the most extensive of the coastal swamps of the United States, and is situated on the Atlantic coast of the United States, extending from the mouth of the Chesapeake Bay to the mouth of the St. Lawrence River. It is bounded on the north by the Chesapeake Bay, on the south by the St. Lawrence River, on the east by the Atlantic Ocean, and on the west by the Appalachian Mountains. The swamp is a vast, low-lying area, covered by a dense growth of marsh vegetation, and is characterized by its extensive areas of open water, which are subject to frequent flooding. The swamp is a rich source of food for a large number of birds, and is also a valuable source of timber. The swamp is a unique and important part of the coastal environment, and its preservation is essential for the health of the coastal ecosystem.



swamp land. The swamp is mainly comprised within the area bounded by the Seaboard Airline Railroad on the north, the Norfolk & Southern Railroad on the south and east, and the Nansemond escarpment on the west. Its margins are often indefinite and merge almost imperceptibly into smaller swamp areas possessing most of the characteristics of the greater swamp. Roughly, the Dismal Swamp is 20 miles wide and 35 miles long, about 40 per cent of its area being in Virginia, the remainder in North Carolina.

Numerous small swamp streams enter the Dismal Swamp from the higher lands of Nansemond County in Virginia and Gates County in North Carolina, the principal ones being Pocoson, Cypress, Moss, Pot Quarter, Corapeake, Polly, Goose, and Jones Creeks. Their course within the swamp has probably never been determined.

In or adjacent to the northerly, easterly and southerly confines of the swamp a number of important rivers have their rise. The Nansemond River and the Elizabeth River, with its three branches, the Western, Southern, and Eastern flow northward and empty into James River and Hampton Roads. North Landing River and Northwest River drain the easterly part of the swamp and flowing southeasterly empty into Carrituck Sound. North, Pasquotank, Little, and Perquimans Rivers lie wholly in North Carolina and flowing southeasterly from the southern part of the swamp empty into Albemarle Sound. All of these rivers in their lower reaches are tidal and are navigable to light or moderate draft boats to near the confines of the Dismal Swamp. Above tide head most of these rivers become sluggish







fresh water streams of a dark brown color rich in finely divided organic matter.

In the northwest quadrant of the Dismal Swamp and situated a little to the east of the Cypress Creek section, which is reported in old surveys to be the highest land in the morass, is Lake Drummond, a shallow body of water of about 4.8 square miles in extent. (See Pl. 1.)

It seems probable that the territory to the east of the swamp is of delta origin from the James River. In the extensive depression between this broad delta and the Nansemond escarpment was formed the Dismal Swamp and Lake Drummond. The latter is the remaining central body of water in the shallow basin which, being encroached upon and overspread by a luxuriant vegetation, has become raised in the course of time by vegetal accumulations to a somewhat higher level than the delta itself, but with gentle dipping slopes to the north, east, and south differentiating the several streams systems leading from the swamp.

A very large part of the Dismal Swamp lies at elevations of 15 to 20 feet above mean sea-level and while the gradients are scarcely perceptible to the eye, yet they are sufficient to affect the degree of drainage and hence the character of the plant covering and the depth and nature of the resultant vegetal accumulation. Considerable of the swamp area is covered with a few inches of standing water for a large portion of the year. During the winter, spring, and early summer months and in the lower situations the depth of water may amount to a foot or



from a water reservoir of a dark brown color with an irregularly divided surface.

Section.

In the western part of the island, there is a small lake, the water of which is very pure and clear. It is in the center of the island, and is surrounded by a low wall of earth. The water is very pure and clear, and is used for drinking. The lake is very small, and is only a few feet deep. It is in the center of the island, and is surrounded by a low wall of earth. The water is very pure and clear, and is used for drinking. The lake is very small, and is only a few feet deep.

It is of a light brown color, and is very pure and clear. It is in the center of the island, and is surrounded by a low wall of earth. The water is very pure and clear, and is used for drinking. The lake is very small, and is only a few feet deep. It is in the center of the island, and is surrounded by a low wall of earth. The water is very pure and clear, and is used for drinking. The lake is very small, and is only a few feet deep.

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two, while during the dry months of early fall long stretches may be traversed dry shod, but in such cases examination always shows that the ground water is very close to the surface.

The principal forest growths are black gum, cypress, red maple, pawpaw, gum, water ash, willow oak, poplar, bay, and toward the marginal portions of the swamp, juniper or white cedar, sweet gum, short-leaf pine, tulip, and water and white oaks. Scattered at intervals throughout the swamp are dense patches of cane-brake, flowering shrubs, tangled vines, and briars forming at times an almost impassable barrier.

The above-mentioned forest growths together with their characteristic environment are responsible for two quite dissimilar types of soil covering known as "black gum" or "dark" swamp and "juniper" or "light" swamp.

The "dark" swamp (see Pl. II, fig. 1) is so called from the black gum, the principal tree, and occupies the low areas subject to complete submergence or to saturation throughout the year. It is practically in its virgin state. In addition to the black gum, with its "root arches", the cypress, with its characteristic enlarged base and "knees", spur-like processes from a few inches to three feet in height believed to be for the purpose of supplying air to the roots, is found in profusion. Red maples and other water-loving trees, for the most part deciduous, are numerous. Centuries of this vegetable growth slowly but persistently laid down and partially decomposed has resulted in the formation of a layer of black muck, probably averaging three feet in thickness, and in places it may be as much as 10 or more feet. The underlying deposits are combinations of sand, silt and clay, and often contain marine shells. When



in very close to the surface.

and there was no more to be said. The matter was closed.

The above-mentioned persons are responsible for the damage done to the property of the Government of India.

The first thing I noticed when I stepped out of the car was the cold. It was a sharp, biting cold that seemed to seep into my bones. I pulled my coat tighter around me and shivered. The air was thick with the scent of pine and the distant sound of a train whistle. I looked up at the dark, overcast sky, feeling a sense of foreboding. The street was empty, the only light coming from the street lamps and the headlights of a car in the distance. I took a deep breath, trying to steady my nerves, and then I walked.



cleared and drained the "dark" lands are easily worked and become very productive (see Pl. II. fig. 2.), though requiring lime to neutralize the organic acids.

The "light" swamp is found on those areas now or formerly covered with the juniper or white cedar tree. It occupies marginal portions of the swamp and other situations usually less wet than the "dark" swamp or at least subject to partial desiccation during the summer months. Under favorable conditions the juniper propagates rapidly and in nearly pure association, but its commercial value has caused the depletion of many of the best tracts, leaving the growth small and scattered. In many instances the cut-over lands have been visited by fire and are now occupied by small trees of other varieties, and by underbrush and cane-brake. The soil and water of the "light" swamp have a strong acid reaction and possess remarkable antiseptic qualities. A proof of their preservative qualities is found in the condition in which the remains of the old juniper forests now exist. The trunks, roots, bark, and leaves of these trees laid down for many years, and but slightly decomposed, form a layer of stringy, reddish brown peat darker toward the bottom and at times 10 feet in thickness. Mineral constituents are almost lacking and its capillary power is therefore small. When the "light" swamp is drained the land is unmanageable, the surface has a tendency to "cake", and under the sun's rays to char and burn. Agriculturally it is considered worthless.

An interesting historical and industrial feature of the Dismal Swamp, and one which has and will in the future have a marked effect on



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land drainage, is the system of canals and ditches which intersect it. These canals had their inception upwards of 125 years ago in the efforts of landowners and lumbermen to secure a means of getting out and marketing the timber of the locality. Amongst these landowners was George Washington. After the Revolutionary War he organized the Dismal Swamp Land Company, and from surveys made by him and through his instrumentality a ditch was dug from the northerly end of Lake Drummond toward Suffolk, Virginia, and which is still known as Washington Ditch.

The Lake Drummond Canal extends from Deep Creek, Virginia, to South Mills, North Carolina, a distance of 22 miles and forms with connecting creeks and rivers an unbroken navigable waterway from Norfolk to Elizabeth City and the Carolina sounds. (See Pl. III, fig. 1.) It was chartered by the States of Virginia and North Carolina in 1787 and was completed in 1826. The effect of this canal with its high spoil banks and the system of locks formerly in use was to intercept much of the drainage which had previously passed to the eastward through Northwest River, and while it promoted land drainage and agricultural operations to the east of the canal, it raised the waters of Lake Drummond and the swamp to the west and retarded similar activities in that direction.

It is probable that Lake Drummond was originally about 6 feet in depth. In 1824 its depth was found by H. Boye to be 12 to 13 feet, its surface  $26\frac{1}{3}$  feet and the summit level of the canal  $19\frac{1}{3}$  feet above tide water. The datum then used was probably mean low water and to reduce the mean sea-level datum used in these investigations, 1.4 feet should



1. The purpose of this study was to determine the effect of the level of the subject's knowledge of the subject matter on the level of the subject's performance on the subject matter.



be subtracted from both of the elevations above given.

The canal was in constant use for navigation purposes up to the close of the war between the States, when it fell into partial disuse. In 1878 C.P.E. Burgwyn, C.E., under Capt. Chas. B. Phillips, Corps of Engineers, U.S.A., found the surface of Lake Drummond to be 22.2 feet above mean low water or about 20.8 feet above mean sea-level, and the former elevation has appeared upon most of the maps of the locality since that time.

In February, 1896, a new company began the work of deepening and enlarging the canal and the feeder from Lake Drummond. (See Pl. III, fig. 2.) Three locks were removed and new ones built at Deep Creek and South Mills forming the present uniform water level 22 miles in length between termini and about  $7\frac{1}{2}$  feet lower than the old summit level. The present canal varies in width on the water line from 70 to 100 feet, and at the bottom from 30 to 40 feet, and the permissible draft is 9 feet. The locks are 250 feet long and 39 feet wide. The cost of canal and fixtures to June 30, 1910, was \$2,059,530.16.<sup>1</sup> The cargo tonnage (2000 lbs.) passed through the canal for the fiscal year ended June 30, 1910, was 361,655 of which 247,880 tons were lumber and other forest products, and 2267 tons were agricultural commodities.

In the fall of 1911 the surface of the water in the canal was 10.9 feet above mean sea-level and both the lake (averaging less than 6 feet deep in November 1899) and canal are now probably lower than for any considerable period of time since white men invaded the region, a circumstance favorable to the extension of land drainage throughout the swamp.

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<sup>1</sup> Report of State Corporation Commission, Virginia, for 1910, p. 237.







With the depletion of the forests (see Pl. IV.) the work of the agriculturist has gone on apace. Landowners have come to see that only through drainage and agricultural utilization could much of the cut-over lands be made of practical value. In addition to a number of successful individual drainage projects in the immediate vicinity of the Pleasant Grove Drainage District, the first attempt at organization under the Virginia Drainage Act of 1910 has been made in the Butts Road District on Indian Creek. Just over the line in North Carolina the Moyock Drainage District has for some time been engaged in dredging a system of ditches looking to the reclamation of about 13,000 acres of the swamp.

Corn and Irish potatoes are the leading crops grown and some of the largest and most productive farms in Virginia are to be found along the northern and eastern borders of the Dismal Swamp. From one farm just north of the Pleasant Grove Drainage District it is stated that 20,000 barrels of potatoes were shipped during the season of 1910.

In the region about the Dismal Swamp the arable lands are largely given up to truck farming, an industry that has assumed proportions of about \$8,000,000 gross sales annually. Norfolk is the center of this industry and the metropolis of the region. With eight railroads centering there and steamers sailing regularly to Washington, Baltimore, Philadelphia, New York, Providence, Boston, and other points, the locality enjoys exceptional transportation facilities and the benefits of one of the best and most suitable markets in the world.







## Soil.

The two principal types of soil covering in the Dismal Swamp have already been discussed.

Both the "light" and the "dark" types have a large water holding capacity, acting much like a sponge, about 20 per cent of their total water content being gravitational water. Saturated they weigh from 65 to 70 pounds per cubic foot. Deprived of gravitational and capillary water the "dark" soil weighs 36 pounds to the cubic foot, while the "light", in an air dry and unpressed condition, may weigh no more than 13 to 15 pounds per cubic foot, of which 80 to 90 per cent is volatile and combustible matter. Very little grit can be detected in either type by the fingers or teeth, and both show decided acidity when tested or tested with blue litmus paper. Lime tends to neutralize the solidity, and drainage and aeration further reduce it, but soils which have been in cultivation for many years are not wholly exempt in this respect.

Very little of the juniper or "light" swamp is to be found in the Pleasant Grove Drainage District, the "dark" swamp constituting practically all of the wooded area over which there is a layer of vegetable matter black in color and ranging from 2½ to 3 feet in thickness. When drained and cultivated this soil becomes very productive (see Pl. II., fig. 2) and retains for a great many years sufficient organic matter to impart a dark color to the land.







The soil of the higher and better drained lands much of which is in cultivation is a sandy vegetable loam. The location of these higher areas within the swamp can often be detected from those of lower elevation by the growth of short-leaf or old-field pine which inhabit the former.

The district is by no means exempt from lands which have become exhausted. Some of the uplands have been tilled for generations and the soil now lacks "fibre". While drainage of such lands will help to improve them, their great necessity is the building up of the soil by turning under leguminous or other green crops and by crop rotation.



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FIG. I.

U.S. DEPARTMENT OF AGRICULTURE OFFICE OF EXPERIMENT STATIONS  
DRAINAGE INVESTIGATIONS

MAP SHOWING  
DISMAL SWAMP SECTION OF VIRGINIA AND NORTH CAROLINA  
AND  
PLEASANT GROVE DRAINAGE DISTRICT AND WATERSHED  
NORFOLK COUNTY, VIRGINIA.

COMPILED FROM PLANS OF U.S. GEOLOGICAL SURVEY,  
VIRGINIA STATE MAPS, AND SURVEYS AND PLANS  
BY THE U.S. DEPARTMENT OF AGRICULTURE

AUGUST 1912.

APPROXIMATE SCALE IN MILES

NOTE: Figures show elevations above Mean Sea Level

12-B-100

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